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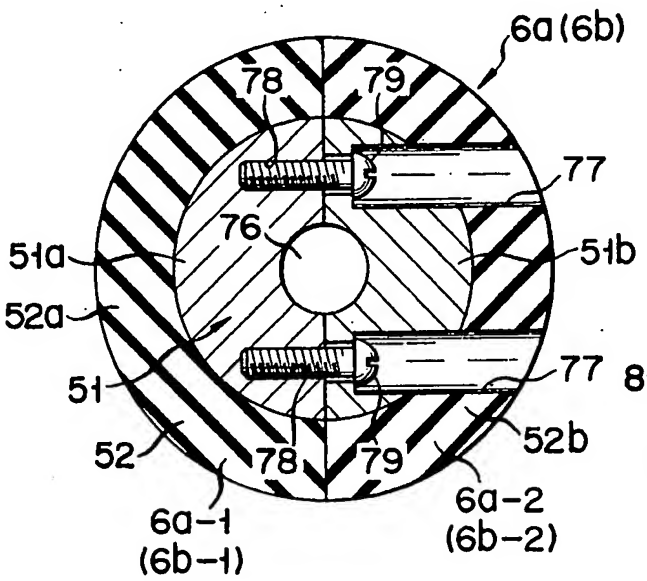
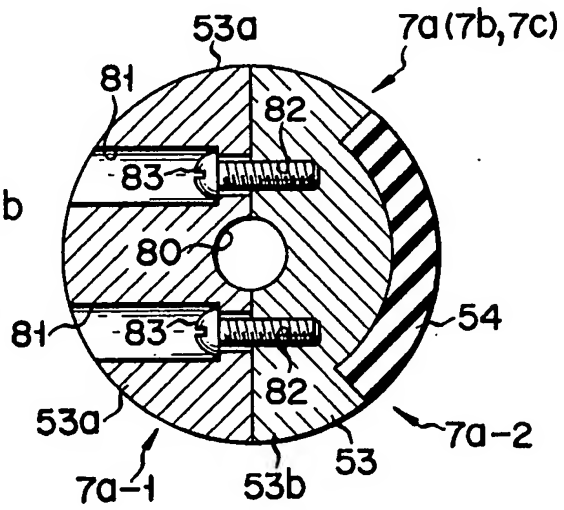
(54) Paper sheet takeout apparatus

(57) A paper sheet takeout device is provided with a roller (6a, 6b, 7a, 7b, 7c) including a cylindrical core member (51a, 51b, 53a, 53b) and a friction member (52, 54) attached to the core member so as to constitute at least part of the outer peripheral surface of the core member, a shaft for rotatably supporting the roller, and a drive mechanism (12 and 13) for rotating the roller supported by the shaft. Paper sheets (P) in frictional engagement with roller are taken out one by one as the roller rotates. The friction member may be in two or more parts secured to a core split along radial lines and detachably secured to a shaft or may be detachably secured to a core which is permanently secured to a shaft.

F I G. 8A



F I G. 9A



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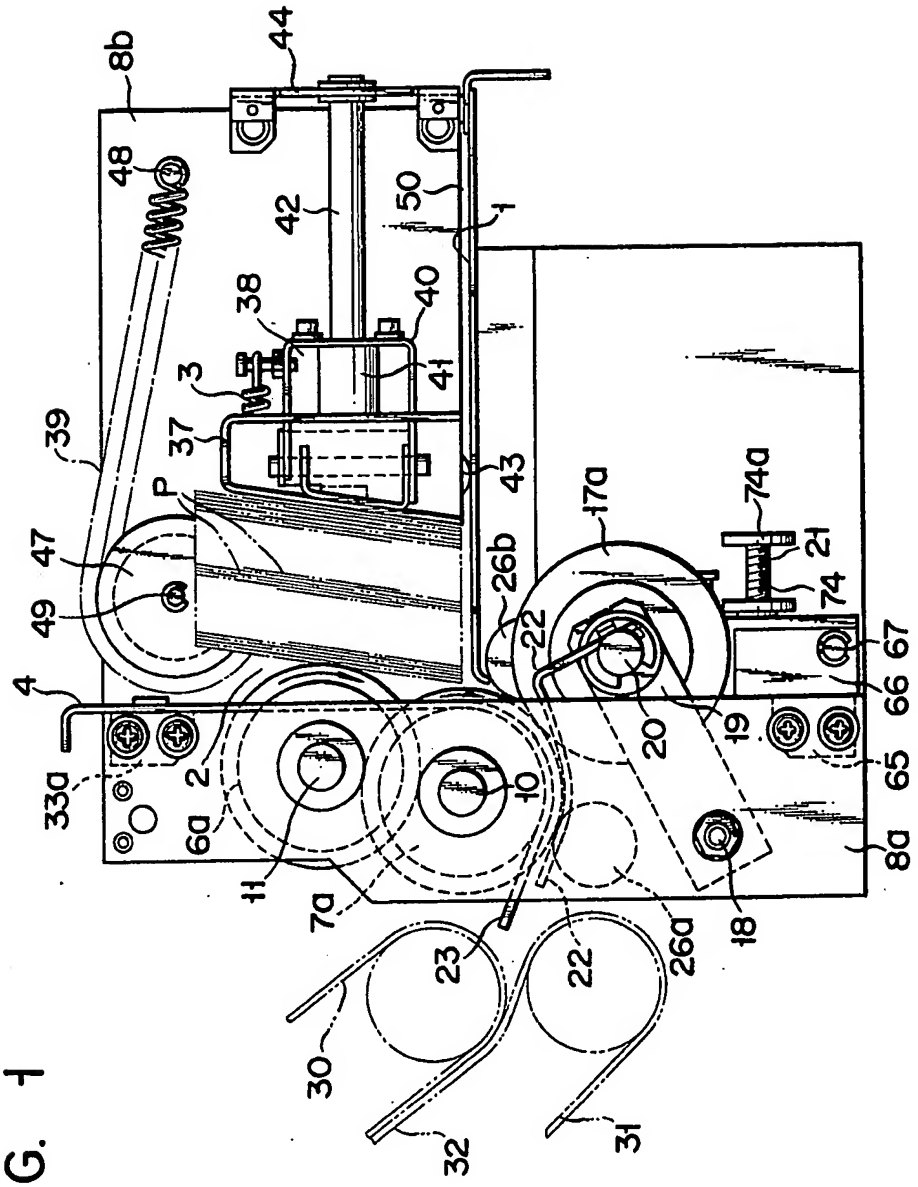

FIG. 1

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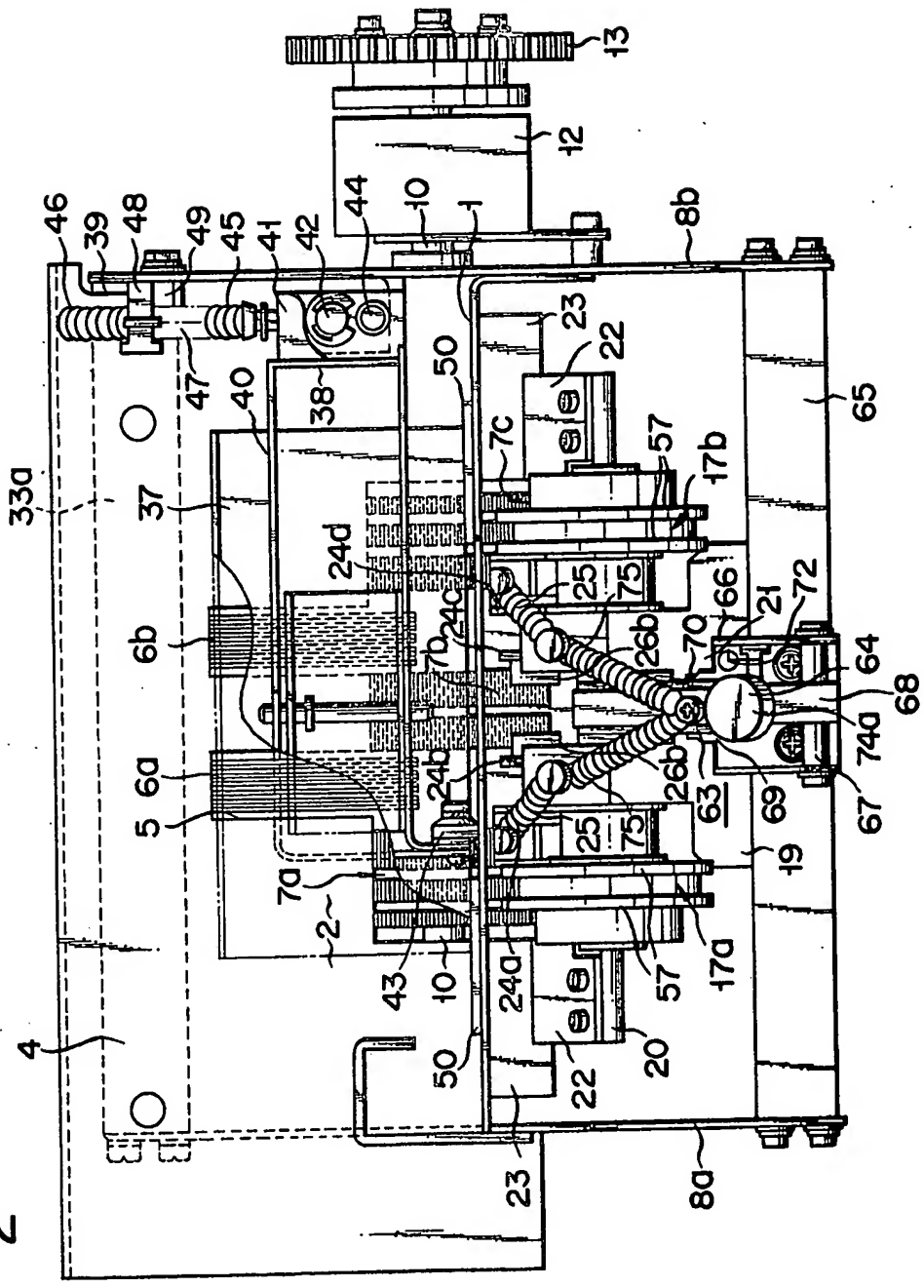

FIG. 2

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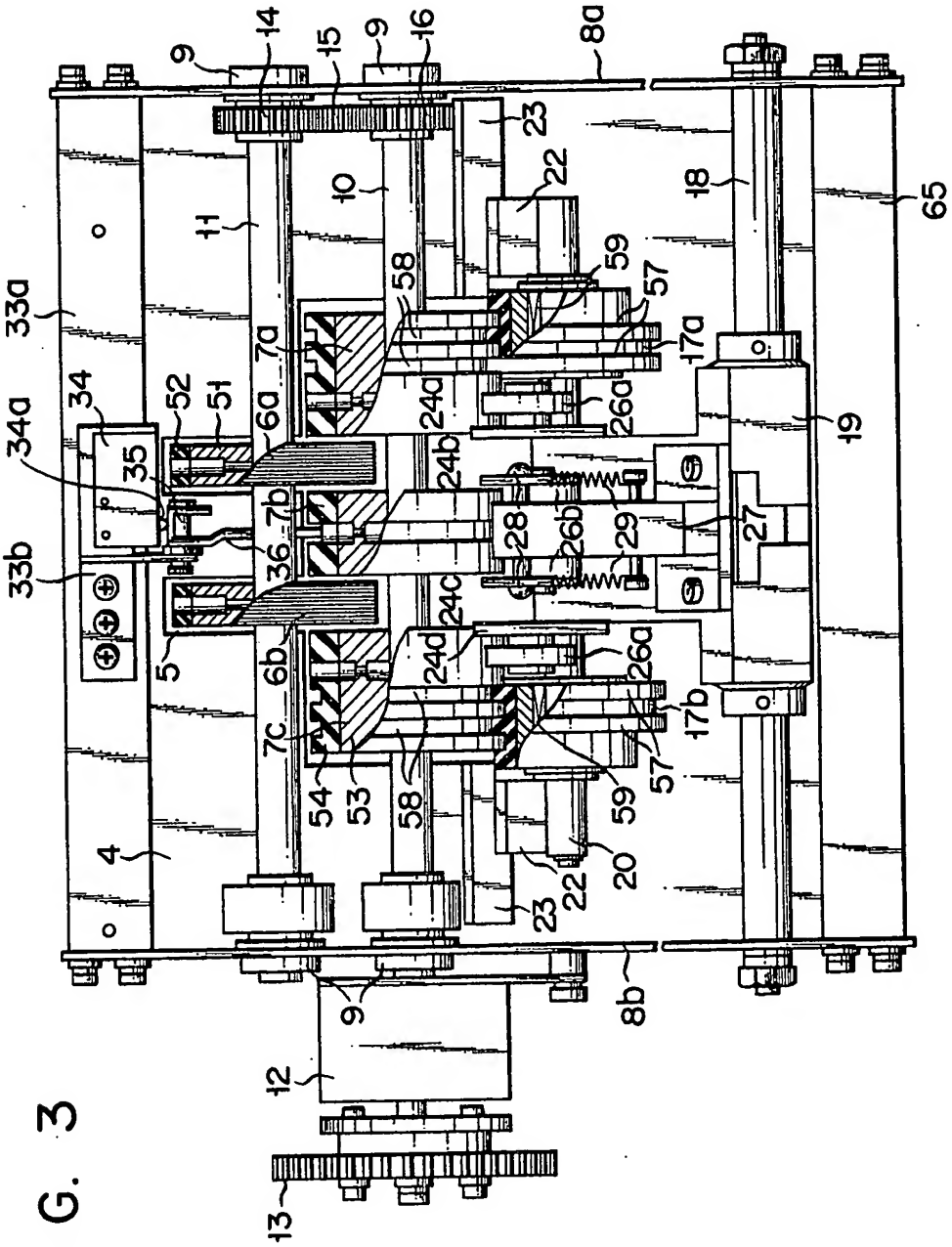

FIG. 3

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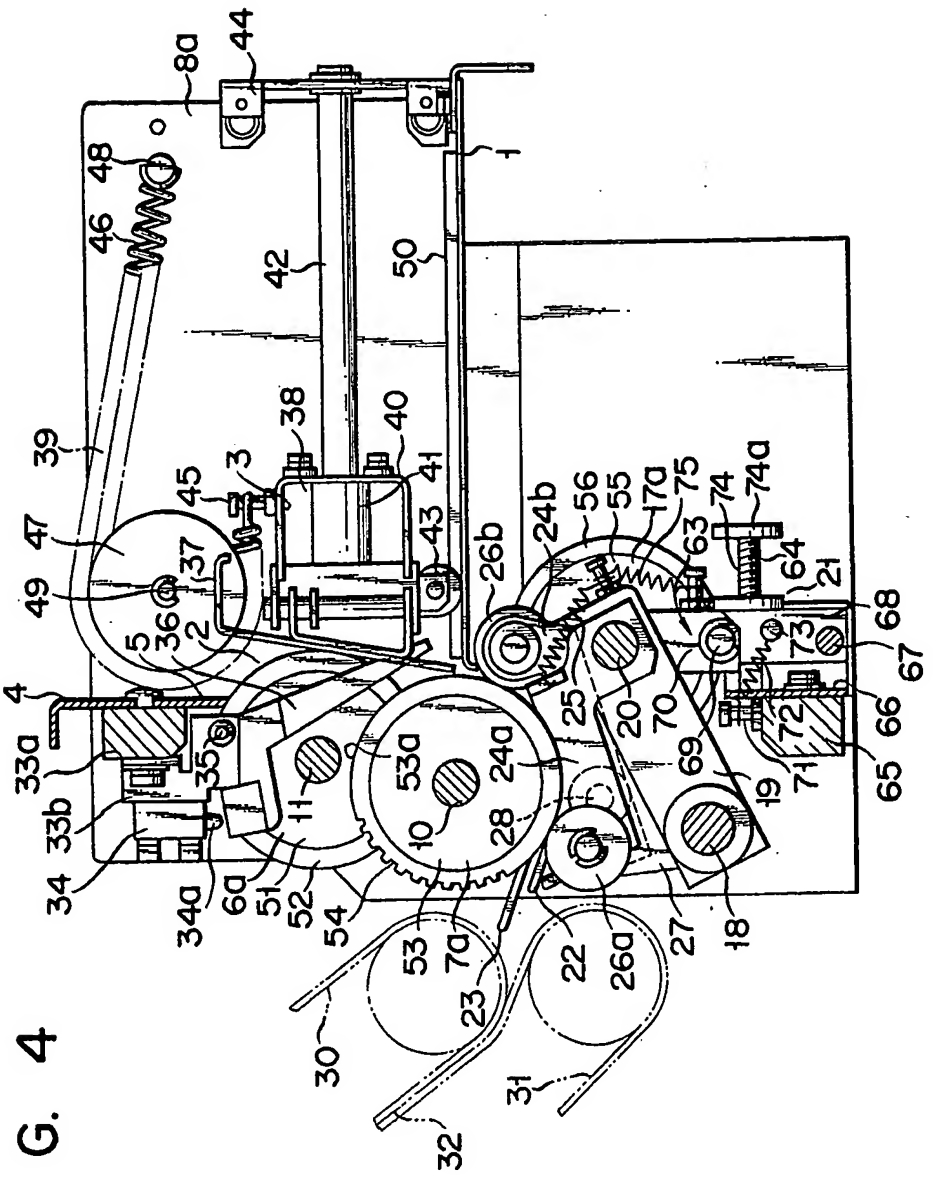

FIG. 4

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FIG. 5A

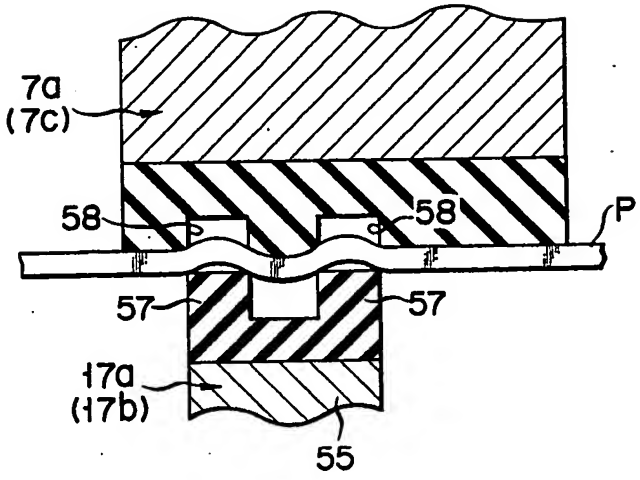

FIG. 5B

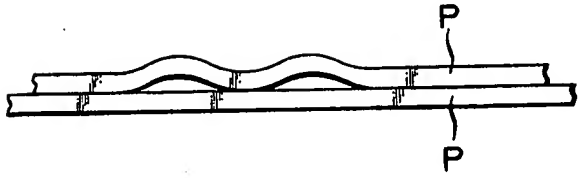

FIG. 6

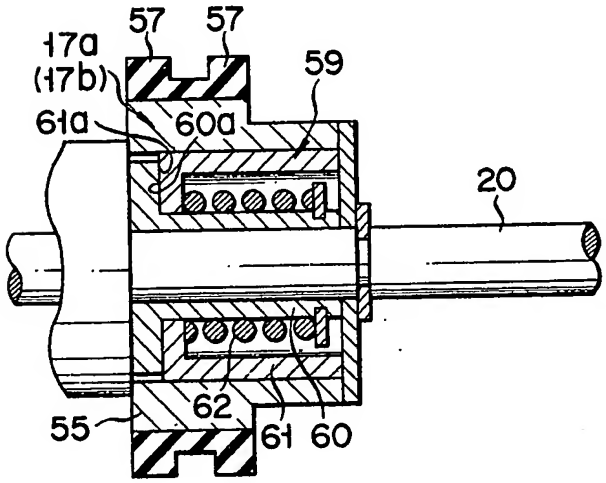

FIG. 7

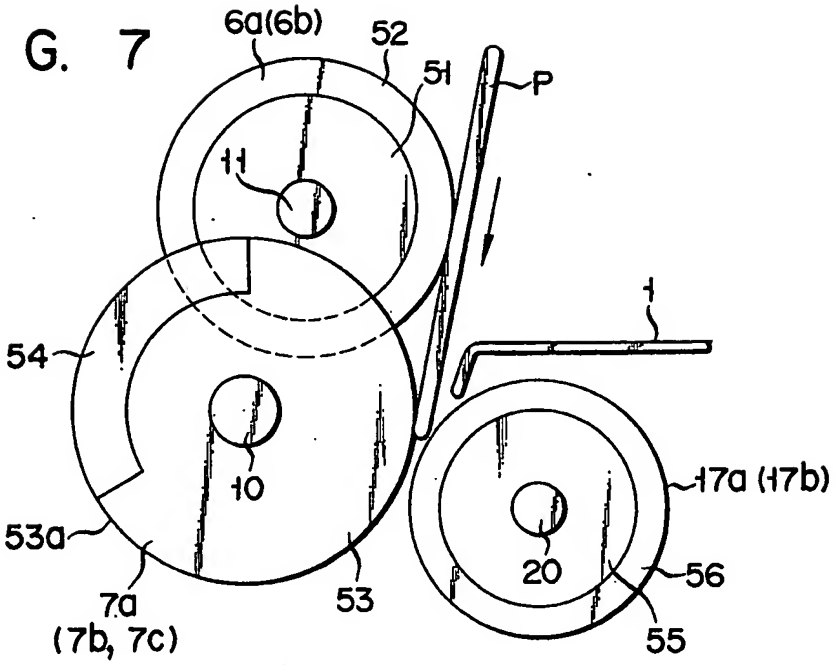

FIG. 8A

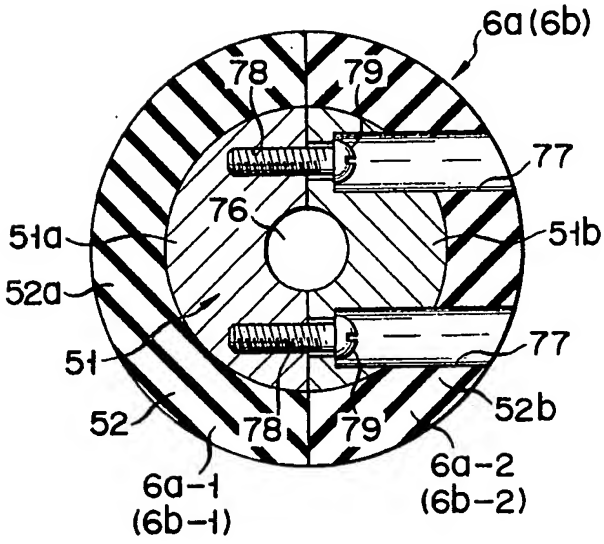

FIG. 8B

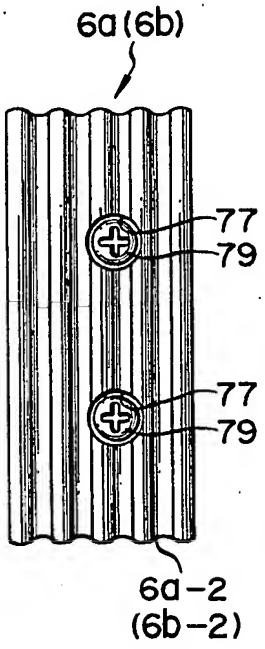

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FIG. 9A

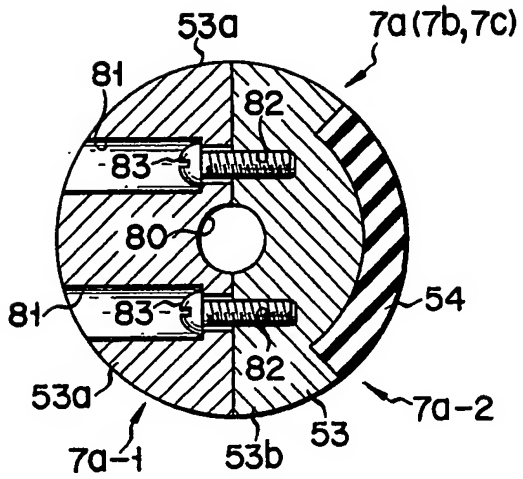

FIG. 9B

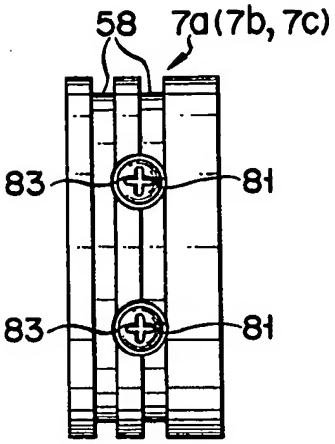

FIG. 10A

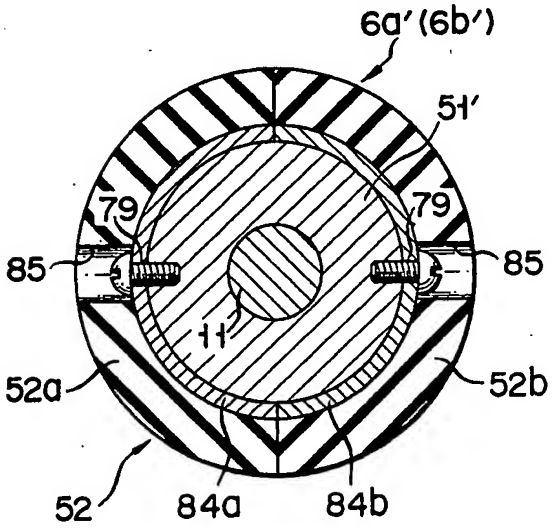

FIG. 10B

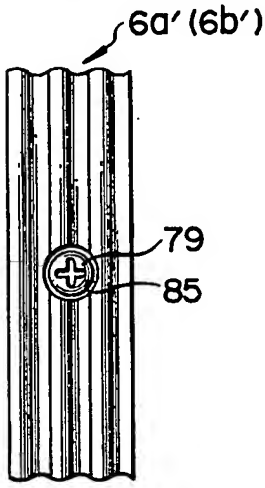

FIG. 11

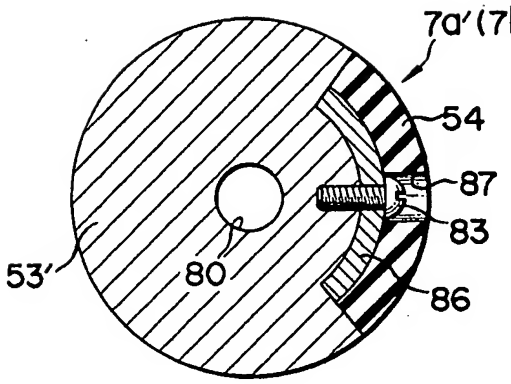

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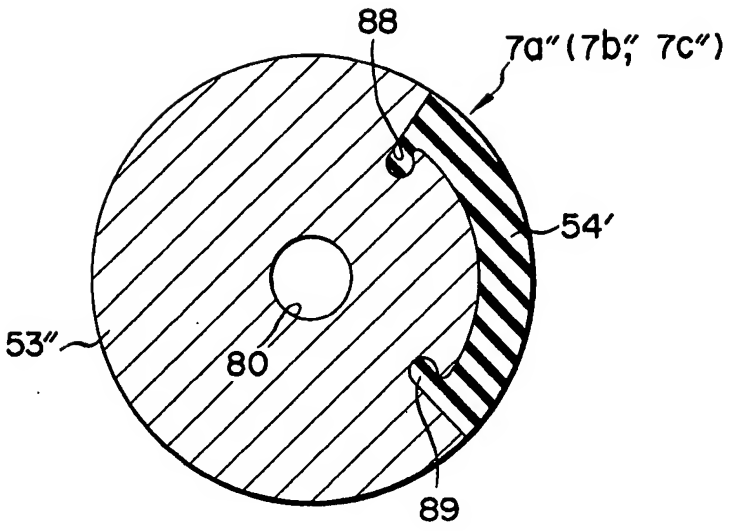
FIG. 12



SPECIFICATION

Paper sheet takeout apparatus

The present invention relates to a paper sheet takeout apparatus for taking out stacked paper sheets, such as bank notes, checks, slips, etc., one after another, and more specifically to an improvement of a paper sheet takeout apparatus facilitating maintenance after prolonged use.

Conventionally, in a takeout apparatus which takes out and feeds paper sheets such as bank notes and checks one by one, the paper sheets stored in a collecting chamber, arranged in a vertical posture are pushed in a predetermined position by a backup member movable along the direction of the arrangement of the paper sheets, abut against a pair of takeout rollers to be in frictional engagement therewith, and are then taken out one after another as they each touch the takeout rollers in rotation.

In the prior art paper sheet takeout apparatus using friction in this manner, a friction member made of rubber or other material with a high coefficient of friction is put on each takeout roller to constitute the outer peripheral surface thereof. However, the friction members will wear away in proportion to the number of paper sheets taken out. It is therefore necessary to replace the friction members periodically.

For stable takeout of paper sheets, the paper sheet takeout apparatus is expected to include feed rollers each having a friction member on the whole outer peripheral surface thereof, takeout rollers each having a friction member on part of the outer peripheral surface thereof, and gate rollers (gap rollers) each having a friction member on the whole or part of its outer peripheral surface, whereby two or more paper sheets are prevented from being taken out at a time. However, these rollers are of an integral structure, and shafts supporting them are supported at both ends by a pair of side bases. In replacing the friction members as expendables, therefore, it is necessary to axially draw out their corresponding rollers after removing one of the side bases. Thus, after the takeout apparatus is once set, replacement of each friction member requires the removal of the side base and readjustment after reassembly, resulting in a waste of time and labor.

The present invention is contrived in consideration of these circumstances, and is intended to provide a paper sheet takeout apparatus including rollers each having a friction member on the outer peripheral surface thereof, whereby paper sheets are taken out one after another, and designed so that the friction member can very easily be replaced without axially attaching and detaching the roller.

In order to attain the above object, a paper sheet takeout apparatus according to the invention is constructed so that a friction member can be attached to and detached from a roller.

According to one aspect of the present invention, there is provided a paper sheet takeout apparatus which comprises a roller including a cylindrical core member and a friction member attached to the core member so as to constitute at least part of the outer peripheral surface of the core member, supporting means for rotatably supporting the roller, and drive means for rotating the roller supported by the supporting means, whereby paper sheets in frictional engagement with the roller are taken out one by one as the roller rotates, in which said friction member is fixed to the core member, and said roller is radially divided into a plurality of parts so that the roller can be attached to and detached from the supporting means, and which further comprises fixing means for removably fixing said plurality of parts to each other around the supporting means.

According to the other aspect of the present invention, there is provided a paper sheet takeout apparatus which comprises a roller including a cylindrical core member and a friction member attached to the core member so as to constitute at least part of the outer peripheral surface of the core member, supporting means for rotatably supporting the roller, and drive means for rotating the roller supported by the supporting means, whereby paper sheets in frictional engagement with the roller are taken out one by one as the roller rotates, in which said friction member is removably attached to the core member, and said core member is fixedly attached to the supporting means, and which further comprises fixing means for removably fixing the friction member to the core member.

This invention can be more fully understood from the following detailed description when taken in conjunction with the accompanying drawings, in which:

Figure 1 is a side view showing one embodiment of a takeout apparatus according to the present invention;

Figure 2 is a front view of the takeout apparatus partially in section;

Figure 3 is a rear view of the takeout apparatus partially in section;

Figure 4 is a side view of the takeout apparatus partially in section;

Figure 5A is a sectional view illustrating the way a paper sheet is held between a gate roller and a takeout roller;

Figure 5B is a side view showing two paper sheets one of which has been held between the gate roller and the takeout roller;

Figure 6 is a sectional view illustrating the way the gate roller is mounted on a shaft;

Figure 7 is a side view showing arrange-

ments of a feed roller, takeout roller and gate roller;

Figures 8A and 8B are a sectional side view and a front view, respectively, showing the construction of the feed roller;

Figures 9A and 9B are a sectional side view and a front view, respectively, showing the construction of the takeout roller;

Figures 10A and 10B are a sectional side view and a front view, respectively, showing the construction of a feed roller used in the other embodiment of the takeout apparatus of the invention;

Figure 11 is a sectional side view showing the construction of a takeout roller used in the other embodiment; and

Figure 12 is a sectional side view showing the construction of a takeiout roller used in a modification of the other embodiment.

One embodiment of a paper sheet takeout apparatus according to the present invention will now be described in detail with reference to the accompanying drawings of Figs. 1 to 9B.

In Fig. 1, numeral 1 designates a collecting base which forms the bottom of a collecting chamber 2. A number of paper sheets P (e.g., about 1,000 sheets) can be collectively stored in the collecting chamber 2, arranged in a vertical posture on the collecting bae 1.

The paper sheets P stored in the collecting chamber 2 are pushed to the left of Fig. 1 by a backup mechanism 3 mentioned later so that the foremost one of the paper sheets P abuts against feed rollers 6a and 6b. The feed rollers 6a and 6b are held in an opening 5 (as shown in Figs. 2 and 3) formed in a front guide plate 4 so that parts of their peripheral edges project into the collecting chamber 2.

As shown in Fig. 3, takeout rollers 7a, 7b and 7c as takeout means and the feed rollers 6a and 6b are mounted on a takeout roller drive shaft 10 and a feed roller drive shaft 11, respectively, which are rotatably supported at both ends thereof on side bases 8a and 8b by means of bearings 9. The feed rollers 6a and 6b are located individually on both sides of the central takeout roller 7b so that the outer peripheral portions of the feed rollers 6a and 6b overlap that of the takeout roller 7b.

One end of the takeout roller drive shaft 10 penetrates one of the bearings 9 to project to the outside of the side base 8b. The projected end of the drive shaft 10 is coupled to the output section of a clutch mechanism 12. As the clutch mechanism 12 is engaged and disengaged, the rotation of a gear 13, which is driven by a drive mechanism (not shown), relative to the takeout roller drive shaft 10 is continued and discontinued, respectively. Thus, the rotation of the takeout roller drive shaft 10 is controlled.

A gear 16 is attached to the other end of the takeout roller drive shaft 10, while a gear 14 is fixed to the other side end of the feed roller drive shaft 11. An intermediate gear 15 is mesh with both of the two gears 14 and 16 is rotatably mounted on the side base 8a. Arranged in this manner, the takeout rollers 7a, 7b and 7c and the feed rollers 6a and 6b rotate simultaneously in the same direction (clockwise direction of Fig. 1).

Gate rollers (gap rollers) 17a and 17b as gate members for preventing takeout of two or more paper sheets P at a time face the outer takeout rollers 7a and 7c, respectively. The gate rollers 17a and 17b are mounted on a gate roller support shaft 20 so that they normally do not rotate. The intermediate portion of the gate roller support shaft 20 is held on the free end of an arm 19, the proximal end portion of which is pivotally fitted on an arm shaft 18 stretched between the two side bases 8a and 8b.

The positions of the gate rollers 17a and 17b can be adjusted by a gate member positioning mechanism 21 mentioned later so that the gaps between the gate rollers 17a and 17b and their corresponding takeout rollers 7a and 7c are just as wide as the thickness of one paper sheet.

The gate roller support shaft 20 is fitted at both end portions with a pair of lower guide plates 22 which support both end portions of the under surface of the paper sheet P taken out by the takeout rollers 7a and 7b. The two lower guide plates 22 face a pair of upper guide plates 23, individually, which are formed of tongues integrally attached to the lower end portion of the front guide plate 4, leaving predetermined spaces between them.

As shown in Fig. 3, four guide plates 24a, 24b, 24c and 24d each having an arcuate guide end face at the top end are arranged in the space under the central takeout roller 7b. Among these four guide plates 24a, 24b, 24c and 24d, the outer two guide plates 24a and 24d, as shown in Fig. 4, are rotatably mounted at one end on the guide roller support shaft 20 which is held by the free end portion of the arm 19. Also, the guide plates 24a and 24d are normally urged in the clockwise direction of Fig. 4 by a pair of springs 25, individually. Thus, a pair of pinch rollers 26a mounted individually on the respective free end sides of the guide plates 24a and 24d are in rolling contact with the bottom portions of the outer peripheral surfaces of the outer takeout rollers 7a and 7c, respectively.

As shown in Figs. 3 and 4, the inner two guide plates 24b and 24c are pivotally mounted on support shafts 28, individually, on a holder 27 which is attached to the arm 19. The guide plates 24b and 24c are normally urged in the counterclockwise direction of Fig. 4 by a pair of springs 29, individually. A pair of pinch rollers 26b are rotatably mounted on the free ends of the guide plates

24b and 24c, individually. Thus, the pinch rollers 26b are in rolling contact with the bottom portion of the outer peripheral surface of the central takeout roller 7b.

A paper sheet P taken out downward from the collecting chamber 2 by the frictional force of the takeout rollers 7a, 7b and 7c is guided by the lower and upper guide plates 22 and 23 for the end portions and by the four guide plates 24a to 24d for the intermediate portion, passing through the one-sheet gaps which are restricted between the gate rollers 17a and 17b and their corresponding takeout rollers 7a and 7c. At this time, the paper sheet P is pressed closely against the outer peripheral surfaces of the takeout rollers 7a, 7b and 7c by the pinch rollers 26a and 26b. Accordingly, the paper sheet P can securely be taken out. The paper sheet P taken out in this manner is fed to a conveyor path 32 which is defined by the opposed faces of conveyor belts 30 and 31, as shown in Figs. 1 and 4, and is delivered to a section to be supplied (not shown) through the conveyor path 32.

As shown in Figs. 3 and 4, a paper sheet detecting switch 34 formed of a microswitch is mounted, by means of a holder 33b, on an upper support rod 33a which supports the two side bases 8a and 8b and on which the front guide plate 4 is fixed. A support shaft 35 is attached to a support strip portion of the holder 33b. A detecting lever 36 is swingably mounted on the support shaft 35, normally urged in the counterclockwise direction of Fig. 4 by a spring (not shown). The free end portion (lower end portion) of the detecting lever 36 projects into the collecting chamber 2 through the opening 5 in the front guide plate 4. If a paper sheet or sheets P exist in the collecting chamber 2, then the distal end of the detecting lever 36 is pushed by the foremost sheet P. Thereupon, the detecting lever 36 swings in the clockwise direction of Fig. 4 to press an operator 34a of the paper sheet detecting switch 34. An indentation is formed in that portion of a backup member 37 of the backup mechanism 3 which corresponds to the distal end portion of the detecting lever 36. Therefore, if there is no paper sheet in the collecting chamber 2, the distal end portion of the detecting lever 36 enters the indentation of the backup member 37. Thus, even if the backup member 37 reaches its advanced position (Fig. 4), the operator 34a of the detecting switch 34 will not be pressed.

As shown in Fig. 4, the backup mechanism 3 includes the backup member 37 in the collecting chamber 2, a support mechanism 38 supporting the backup member 37 for reciprocation, and an urging mechanism 39 normally urging the backup member 37 toward the advanced position. The support mechanism 38 includes a movable member 40 which is fitted with the backup member 37. The movable member 40 is mounted on a guide shaft 42 by means of a slide bearing 41 attached to one end of the movable member 40. A guide roller 43 is attached to the other end of the under surface of the movable member 40. The guide roller 43 is in rolling contact with the bottom of the collecting chamber 2, i.e., the collecting base 1, so that the backup member 37 can reciprocate along the direction of the arrangement of the paper sheets P in the collecting chamber 2. The guide shaft 42 is held at both end portions by a pair of shaft holders 44 (only one is shown in Figs. 1 and 4) attached to the side base 8a.

The urging mechanism 39 is constructed as follows. A spring peg 45 protrudes from one end portion of the top surface of the movable member 40. One end of a carrier spring (tension spring) 46 is retained by the peg 45. As shown in Figs. 1, 2 and 4, the middle portion of the carrier spring 46 is passed around a guide roller 47 on the side of the advanced position of the backup member 37. The other end of the carrier spring 46 is retained by a spring peg 48 protruding from that portion of the side base 8a on the side of a retreated position of the backup member 37. A support shaft 49 supporting the guide roller 47 and the spring peg 48 are attached to the side base 8b. In the backup mechanism 3 constructed in this manner, the backup member 37 attached to the movable member 40 is normally urged toward the advanced position by the restoring force of the carrier spring 46, so that the paper sheets P in the collecting chamber 2 are pressed against the feed rollers 6a and 6b with a proper force for takeout.

A pair of belt-shaped guide plates 50 formed of a low-friction material are pasted on the bottom of the collecting chamber 2 or the collecting base 1. The guide plates 50 support the bottom edges of the paper sheets P for smooth movement thereof.

As shown in Figs. 3 and 4, the feed rollers 6a and 6b each include a roller body 51 as a metal core and a friction member 52 such as rubber formed on the whole peripheral surface of the roller body 51 by baking. A plurality of grooves are formed on the outer peripheral surface of the friction member 52 along the rotating direction or the circumferential direction thereof.

As shown in Figs. 3 and 4, the takeout rollers 7a, 7b and 7c are partial friction rollers which each includes a roller body 53 as a metal core and a friction member 54 such as rubber buried in an indentation formed in part (for a center angle of about 100°) of the outer peripheral surface of the roller body 53. The radius of curvature of the outer peripheral surface of the friction member 54 is substantially equal to the radius of the cross section of the roller body 53. A plurality of grooves

are formed on the outer peripheral surface of the friction member 54 along the direction perpendicular to the rotating direction of the roller body 53, that is, in the axial direction. The outer peripheral surface of the friction member 54 is somewhat projected from a low-friction part 53a or the other part of the outer peripheral surface of the roller body 53 than the indentation.

As shown in Figs. 3 and 4, the gate rollers 17a and 17b each includes a roller body 55 as a metal core and a friction member 56 such as rubber put on the whole peripheral surface of the roller body 55 by baking. The friction members 56 of the gate rollers 17a and 17b are lower in coefficient of friction than the friction members 54 of the gate rollers 7a, 7b and 7c. Thus, the paper sheets P are taken out smoothly by the takeout rollers 7a, 7b and 7c.

As shown in Figs. 2, 3 and 5A, a pair of ridges 57 are formed on the peripheral surface of each of the gate rollers 17a and 17b, covering the whole circumference thereof. Individually facing the ridges 57, a pair of grooves 58 are formed on the outer peripheral surface of each of the takeout rollers 7a and 7c which face the gate rollers 17a and 17b, respectively. With this arrangement, each paper sheet P taken out by the frictional force of the takeout rollers 7a, 7b and 7c is partially corrugated, as shown in Fig. 5A. Thus, gaps are formed between the paper sheet P to be taken out and a subsequent paper sheet P, as shown in Fig. 5B, to reduce the surface pressure, thereby preventing two or more superposed paper sheets from being easily taken out at a time.

As shown in Fig. 6, each of the gate rollers 17a and 17b is mounted on the gate roller support shaft 20 by means of a torque limiter 59. Constructed in this manner, the gate rollers 17a and 17b are adapted to be normally stopped and to rotate only when they are subjected to a very great force. Thus, the paper sheets P are protected against damage. The torque limiter 59 includes a first hub 60 fixedly fitted on the support shaft 20, a second hub 61 slidably fitted on the first hub 60, and a spring 62 for pressing sliding surfaces 60a and 61a, i.e., the opposed faces of flange portions of the hubs 60 and 61, against each other. Each of the gate rollers 17a and 17b is fixedly fitted on the second hub 61. Thus, if a great force is applied to the gate roller 17a or 17b, a rocking force greatwer than the frictional pressure between the sliding surfaces 60a and 61a given by the spring 62 is produced, so that the sliding surfaces 60a and 61a slip on each other, causing the gate roller 17a or 17b to rotate.

As shown in Figs. 2 and 4, the gate member positioning mechanism 21 includes a link mechanism 63 for holding the gate rollers 17a and 17b so that the rollers 17a and 17b can move in directions for engagement with or disengagement from the takeout rollers 7a and 7c, and a link fixing mechanism 64 for fixing links so that the gaps between the gate rollers 17a and 17b held by the link mechanism 63 and the takeout rollers 7a and 7c have a desired width. A holder 66 is attached to the middle portion of a lower support rod 65 which supports the side bases 8a and 8b. A support shaft 67 is stretched between the side bases 8a and 8b, extending parallel to the gate roller support shaft 20. The lower end portion of a lower link 68 is coupled to the holder 66 by means of the support shaft 67. The upper end portion of the lower link 68 is coupled to the lower end portion of an upper link 70 by means of a coupling pin 69. The upper end portion of the upper link 70 is coupled to the gate roller support shaft 20. The arm 19 and the upper and lower links 70 and 68 constitute the link mechanism 63, whereby the gate rollers 17a and 17b are held for engagement with or disengagement from the takeout rollers 7a and 7b.

One end of a spring 72 is retained by a spring peg 71 one end of which is attached to the lower support rod 65. The other end of the spring 72 is coupled to the lower link 68 by means of a spring peg 73. The lower link 68 is normally urged in the counterclockwise direction of Fig. 4 around the support shaft 67 by the spring 72. Thus, the lower and upper links 68 and 70 are normally urged to be arranged substantially in a straight line, so that the free end portion of the arm 19 is pushed up in a direction such that the gate rollers 17a and 17b approach the takeout rollers 7a and 7c, respectively.

An adjust screw 74 as link supporting means is screwed in the lower link 68. The tip end of the adjust screw 74 is pressed against the holder 66 to support the lower link 68 in position against the urging force of the spring 72. If the adjust screw 74 is turned in its advancing direction, the lower link 68 rocks clockwise around the support shaft 67 against the urging force of the spring 72, making a relatively narrow angle with the upper link 70. Accordingly, the distance in a straight line between the support shaft 67 and the gate roller support shaft 20 is shortened. Then, the arm 19 rocks in the clockwise direction of Fig. 4 around the arm shaft 18 to compensate the reduction of the distance. As a result, the gate rollers 17a and 17b are removed a short distance from the takeout rollers 7a and 7c, respectively. If the adjust screw 74 is turned in its retreating direction, on the other hand, the angle between the upper and lower links 70 and 68 coupled by the coupling pin 69 is widened. Accordingly, the distance in a straight line between the support shaft 67 and the gate roller support shaft 20 is extended. Then, the arm 19 rocks in the counterclockwise direction of Fig. 4 around the arm

shaft 18 to compensate the extension of the distance. As a result, the gate rollers 17a and 17b slightly approach the takeout rollers 7a and 7c, respectively.

Thus, the gaps between the gate rollers 17a and 17b and the takeout rollers 7a and 7c can accurately be adjusted to a desired width by only turning the adjust screw 74 in either direction.

A knob 74a of the adjust screw 74 functions as a release knob for separating the gate rollers 17a and 17b wide apart from the takeout rollers 7a and 7c. Namely, by pulling the knob 74a against the urging force of the spring 72, the angle between the upper and lower links 70 and 68 is greatly changed so that the gate rollers 17a and 17b are separated wide from the takeout rollers 7a and 7c.

As shown in Figs. 2 and 4, the arm 19 and the lower link 72 are elastically coupled by a pair of springs 75 so that the link mechanism 63 is free from backlash.

The operation of the takeout apparatus of the aforementioned construction will now be described. The paper sheets P collectively stored in the collecting chamber 2, arranged in a vertical posture are pushed forward by the backup member 37 which is urged toward the advanced position by the restoring force of the carrier spring 46. Thus, the foremost paper sheet P is pressed, under a proper contact pressure for takeout, against the outer peripheral surfaces of the feed rollers 6a and 6b whose peripheral edges partially project into the collecting chamber 2 through the opening 5 in the front guide plate 4. At the same time, the distal end of the detecting lever 36 is pushed by the paper sheet P, so that the detecting lever 36 rockes against the urging force of the spring (not shown) to press the operator 34a of the paper sheet detecting switch 34. Thus, the detecting switch 34 detects "presence".

Meanwhile, the drive source (not shown) is started in response to a "presence" signal from the paper sheet detecting switch 34 or a start signal from a start switch (not shown). Thereupon, the gear 13 starts to rotate, and the conveyor belts 30 and 31 constituting the conveyor path 32 for transferring the paper sheets P starts running.

Subsequently, when a takeout signal is inputted, the clutch mechanism 12 is thrown in, so that the driving force of the gear 13 is transmitted to the takeout roller support shaft 10. At the same time, the feed roller support shaft 11, which is associated with the takeout roller support shaft 10 by means of the gears 16, 15 and 14, starts to rotate. Accordingly, the feed rollers 6a and 6b and the takeout rollers 7a, 7b and 7c mounted on the support shafts 10 and 11 start to rotate simultaneously. Thereupon, the foremost paper sheet P is fed by the frictional force of the feed rollers 6a and 6b so that its securely opposed to the takeout rollers 7a, 7b and 7c. Then, the friction members 54 on the parts of the outer peripheral surfaces of the takeout rollers 7a, 7b and 7c face and touch the lower front edge of the formost paper sheet P. Thus, the foremost paper sheet P is taken out downward by the friction with the friction members 54.

The foremost paper sheet P taken out in this manner is then carried out by the pinch rollers 26b and 26a as it is closely in contact with the takeout rollers 7a, 7b and 7c. Then, the paper sheet P is fed into the conveyor path 32 between the conveyor belts 30 and 31, guided by the upper and lower guide plates 23 and 22 for its end portions and by the arcuate guide end faces of the guide plates 24a to 24d for its middle portion.

The foremost paper sheet P to be taken out is partially corrugated by being held between the ridges 57 on the outer peripheral surfaces of the gate rollers 17a and 17b and the grooves 58 on the outer peripheral surfaces of the takeout rollers 7a and 7c. As a result, the contact area between the foremost paper sheet P and a subsequent paper sheet P is reduced, as described before with reference to Fig. 5B. The second and further succeeding paper sheets P are arrested by the gate rollers 17a and 17b which face the takeout rollers 7a and 7c with the gaps for one paper sheet between them. Thus, the paper sheets P in the collecting chamber 2 are taken out one after another with every rotation of the takeout rollers 7a, 7b and 7c. The takeout speed is set about 10 sheets per second.

When all the paper sheets P in the collecting chamber 2 are taken out, the paper sheet detecting switch 34 detects "absence". In response to this, the takeout rollers 7a, 7b and 7c and the feed rollers 6a and 6b cease to rotate. This is the end of the takeout operation.

Referring now to Figs. 7 to 9B, the constructions of the feed rollers 6a and 6b, the takeout rollers 7a, 7b and 7c, and the gate rollers 15a and 15b, which constitute a feature of the present invention, will be described in detail.

As shown in Fig. 7, the takeout rollers 7a, 7b and 7c are removably mounted on the takeout roller drive shaft 10; the feed rollers 6a and 6b on the feed roller drive shaft 11 and the gate rollers 15a and 15b on the gate roller support shaft 20. The shafts 10, 11 and 20 are supported at both ends by the bearings 9 mounted on the side bases 8a and 8b, as described before with reference to Fig. 3. Therefore, if the rollers 7a, 7b, 7c, 6a, 6b, 17a and 17b were of an integral structure, they could not be removed from their corresponding shafts 10, 11 and 20 unless one of the side bases 8a and 8b is removed.

In the takeout apparatus of said one embodiment, however, the rollers 6a, 6b, 7a,

7b, 7c, 17a and 17b are each divided radially. Therefore, the rollers 6a, 6b, 7a, 7b, 7c, 17a and 17b can be attached to and detached from their corresponding shafts 10, 11 and 20 without removing the side base 8a or 8b. Thus, it is easy to cope with abrasion of the friction member 52, 54 or 56, if any.

As mentioned before, the feed rollers 6a and 6b are each formed of the cylindrical core member 51 and the friction member 52 put on the whole outer peripheral surface of the core member 51 by baking. As shown in Figs. 8A and 8B, the core member 51 and the friction member 52 are each radially divided into two parts bounded by the diameter of the feed roller 6a and 6b which passes through a fitting hole 76 which is formed in the center of the core member 51. Namely, each of the feed rollers 6a and 6b is divided into two half sections; a first half member 6a-1 or 6b-1 which is formed of a semicylindrical first core member portion 51a and a first friction member portion 52a put on the whole outer peripheral surface thereof by baking, and a second half member 6a-2 or 6b-2 which is formed of a semicylindrical second core member portion 51b and a second friction member portion 52b put on the whole outer peripheral surface thereof by baking.

A pair of screw guide holes 77 extending through the second core member portion 51b and the second friction member portion 52b are formed in the second half member 6a-2 (6b-2). Also, a pair of tapped holes 78 extending in the first core member portion 51a are formed in the first half member 6a-1 (6b-1) in a manner such that the tapped holes 78 are aligned with the screw guide holes 77, respectively, when the first and second half members 6a-1 (6b-1) and 6a-2 (6b-2) are jointed together. The first and second half members 6a-1 (6b-1) and 6a-2 (6b-2) are firmly coupled by screwing threaded portions of a pair of fixing screws 79 into the individual tapped holes 78 through their corresponding screw guide holes 77. The fitting hole 76 is formed in the center of the feed roller 6a (6b) when the first and second half members 6a-1 (6b-1) and 6a-2 (6b-2) are coupled in this manner. The head of each fixing screw 79, when secured, is located in its corresponding guide hole 77 without projecting outside.

Thus, the feed roller 6a (6b) can be radially divided in two for detachment from the drive shaft 11 by only removing the two fixing screws 79. Namely, the friction member portions 52a and 52b can be replaced.

As mentioned before, moreover, the takeout rollers 7a, 7b and 7c are each formed of the core member 53 and the friction member 54 buried in the indentation formed in part (for a center angle of about 100°) of the outer peripheral surface of the core member 53. As shown in Figs. 9A and 9B, the core member 53, like the core member 51 of the feed roller 6a (6b), is radially divided into two parts bounded by the diameter of the takeout roller 7a (7b, 7c) which passes through a fitting hole 80 which is formed in the center of the core member 53. Namely, each of the takeout rollers 7a, 7b and 7c is divided into two half sections; a first semicylindrical half member 7a-1 (7b-1, 7c-1) which is formed of a first core member portion 53a, and a second semicylindrical half member 7a-2 (7b-2, 7c-2) which is formed of a second core member portion 53b and the friction member 54 buried in part of the outer peripheral surface of the second core member portion 53b. A pair of screw guide holes 81 are formed in the first half member 7a-1 (7b-1, 7c-1). Also, a pair of tapped holes 82 are formed in the second half member 7a-2 (7b-2, 7c-2) in a manner such that the tapped holes 82 are aligned with the screw guide holes 81 when the first and second half members 7a-1 (7b-1, 7c-1) and 7a-2 (7b-2, 7c-2) are jointed together. The first and second half members 7a-1 (7b-1, 7c-1) and 7a-2 (7b-2, 7c-2) are firmly coupled by screwing threaded portions of a pair of fixing screws 83 into the individual tapped holes 82 through their corresponding screw guide holes 81. The fitting hole 80 is formed in the center of the takeout roller 7a (7b, 7c) when the first and second half members 7a-1 (7b-1, 7c-1) and 7a-2 (7b-2, 7c-2) are coupled in this manner.

Thus, the takeout roller 7a (7b, 7c) can be radially divided in two for detachment from the drive shaft 10 by only removing the two fixing screws 83. Namely, the friction member 54 can be replaced. Since no screw guide hole is formed in the friction member 54, there is no possibility of partial extraordinary abrasion. It is confirmed by an experiment that a hole or indentation in the surface of the friction member 54, if any, is liable to cause local abrasion.

Also, the gate rollers 17a and 17b are each formed of the core member 55 and the friction member 56 on the outer peripheral surface thereof, and like the feed rollers 6a and 6b, are each divided into two parts. Therefore, detailed description of the construction of the gate rolles 17a and 17b will be omitted herein.

It is to be understood that the present invention is not limited to said one embodiment described above, and that various changes and modifications may be effected therein by one skilled in the art without departing from the scope or spirit of the invention.

In said one embodiment described above, the feed roller 6a is entirely removed from the shaft 11 by radially dividing the core member 51 in replacing the friction member 54 of the feed roller 6a, for example. As shown as the other embodiment in Figs. 10A and 10B,

however, a takeout roller 6a' (6b') may be formed by previously fixing a cylindrical core member 51' to the drive shaft 11, then putting only the friction member 52 on the outer peripheral surfaces of a pair of semicylindrical auxiliary metal fittings 84a and 84b by baking, and finally fixing the auxiliary metal fittings 84a and 84b with the friction member 52 thereon to the core member 51' by means of the fixing screws 79 passed through guide holes 85 which are formed in the friction member 52 and the auxiliary metal fittings 84a and 84b. Thus, although the feed roller 6a' (6b') is different in structure from the feed roller 6a (6b) of the first embodiment, the former can produce the same effect as the latter. Namely, if the friction member 52 of the feed roller 6a' is worn away, it can be desengaged together with the auxiliary metal fittings 84a and 84b from the core member 51' for replacement by removing the fixing screws 79. Thus, the friction member 52 can be replaced without removing the shaft 11 from the side bases 8a and 8b.

The spirit of the other embodiment is reflected in a takeout roller 7a' (7b', 7c'), as shown in Fig. 11, as well as in the feed roller 6a' (6b'). The takeout roller 7a' is formed of a cylindrical core member 53' and the friction member 54 removably fitted in an indentation formed in part (for a center angle of about 100°) of the outer peripheral surface of the core member 53'. The friction member 54 is put on an arcuate auxiliary metal fitting 86 by baking. The friction member 54 on the auxiliary metal fitting 86 is fixed to the core member 53' by means of a fixing screw 88 passed through a guide hole 87 which is formed in both the auxiliary metal fitting 86 and the friction member 54.

The takeout roller 7a' of the other embodiment may be modified as follows as a modification. As shown in Fig. 12, a core member 53'' and a friction member 54' according to the modification may be dove tail jointed without using a screw. More specifically, a pair of grooves 88 are provided on the bottom of the indentation of the core member 53'' and a pair of protrusion 89 are integrally formed on the friction member 54'. In attaching the friction member 54' to the core member 53'', the protrusions 89 are forcibly pushed into the grooves 88. In this way, the friction member 54' is reliably attached to the core member 53'' without using a screw. The friction member 54' never disengages from the core member 53'' during a normal operation mode.

In the takeout roller 7a' (7b', 7c') constructed in this manner, the friction member 54 can be replaced easily without removing the shaft 10 from the side bases 8a and 8b.

Although each roller is radially divided into two parts in the foregoing embodiments, it is to be understood that it may be divided into three or more parts.

According to the present invention, as described herein, there is provided a paper sheet takeout apparatus which is provided with rollers each having a friction member on the outer peripheral surface thereof, whereby paper sheets are taken out one after another. Since each roller can be radially divided in attachment and detachment, the friction member can very easily be replaced without axially attached and detaching the roller.

CLAIMS

1. In a paper sheet takeout apparatus which comprises a roller including a cylindrical core member and a friction member attached to the core member so as to constitute at least part of the outer peripheral surface of the core member, supporting means for rotatably supporting the roller, and drive means for rotating the roller supported by the supporting means, whereby paper sheets in frictional engagement with the roller are taken out one by one as the roller rotates,

the improvement in which said friction member is fixed to the core member; and

said roller is radially divided into a plurality of parts so that the core member can be attached to and detached from the supporting means, and

the improvement which comprises fixing means for removably fixing said plurality of parts to each other around the supporting means.

2. The takeout apparatus according to claim 1, wherein said friction member is formed on the whole outer peripheral surface of the core member, and is divided into a plurality of parts corresponding to said parts of the core member.

3. The takeout apparatus according to claim 2, wherein said fixing means includes through holes formed in said individual parts and those portions of the friction member which are fixed to said parts, tapped holes formed in the individual parts and each alingning with the through hole of each adjacent part, and screws fitted individually in the tapped holes through the through holes, thereby firmly coupling said parts adjoining one another around the supporting means.

4. The takeout apparatus according to claim 3, wherein the head of each said screw is located in each corresponding through hole.

5. The takeout apparatus according to claim 1, wherein said friction member is provided on the outer peripheral surface of one of said parts of the divided core member.

6. The takeout apparatus according to claim 5, wherein said fixing means includes through holes formed in those ones of said parts which do not bear the friction member thereon, tapped holes formed in that part which bears the friction member thereon and aligning individually with the through holes,

and screws fitted individually in the tapped holes through the through holes, thereby firmly coupling said parts adjoining one another around the supporting means.

7. The takeout apparatus according to claim 6, wherein the head of each said screw is located in each corresponding through hole.

8. In a paper sheet takeout apparatus which comprises a roller including a cylindrical core member and a friction member attached to the core member so as to constitute at least part of the outer peripheral surface of the core member, supporting means for rotatably supporting the roller, and drive means for rotating the roller supported by the supporting means, whereby paper sheets in frictional engagement with the roller are taken out one by one as the roller rotates,

the improvement in which said friction member is removably attached to the core member; and

said core member is fixedly attached to the supporting means, and

the improvement which comprises fixing means for removably fixing the friction member to the core member.

9. The takeout apparatus according to claim 8, wherein said friction member is formed on the whole outer peripheral surface of the core member, and is divided into a plurality of parts.

10. The takeout apparatus according to claim 9, wherein each said part of the friction member is provided with a reinforcing plate on the whole inner peripheral surface thereof.

11. The takeout apparatus according to claim 10, wherein each said part of the friction member and each corresponding reinforcing plate are fixed to each other.

12. The takeout apparatus according to claim 11, wherein said fixing means includes through holes formed in said individual parts and the reinforcing plates fixed to said parts, tapped holes formed in the outer peripheral surface of the core member and aligning individually with the through holes, and screws fitted individually in the tapped holes through the through holes, thereby firmly coupling said parts to the outer peripheral surface of the core member.

13. The takeout apparatus according to claim 12, wherein the head of each said screw is located in each corresponding through hole.

14. The takeout apparatus according to claim 8, wherein said friction member is provided on part of the outer peripheral surface of the core member.

15. The takeout apparatus according to claim 14, wherein said friction member is provided with a reinforcing plate on the whole inner peripheral surface thereof.

16. The takeout apparatus according to claim 15, wherein said friction member and said reinforcing plate are fixed to each other.

17. The takeout apparatus according to claim 16, wherein said fixing means includes a through hole formed in the friction member and the reinforcing plate, a tapped hole formed in the core member and aligning with the through hole, and a screw fitted in the tapped hole through the through hole, thereby firmly coupling the friction member to the core member.

18. The takeout apparatus according to claim 17, wherein the head of said screw is located in the through hole.

19. The takeout apparatus according to claim 8, wherein said fixing means includes a dove tail joint.

20. A paper sheet takeout apparatus, substantially as hereinbefore described with reference to the accompanying drawings.

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